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THE JUST TRANSITION FROM A GEOGRAPHICAL PERSPECTIVE



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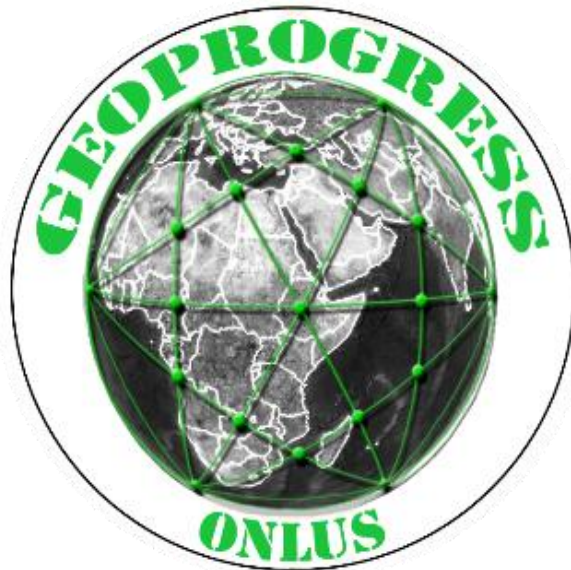
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Volume 12, Special Issue 1, 2025

**THE JUST TRANSITION
FROM A GEOGRAPHICAL PERSPECTIVE**

Edited by

Maria Giuseppina Lucia, Monica Maglio, Francesca Silvia Rota



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NOVARA**

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TABLE OF CONTENTS

| | |
|--|-----|
| Editorial Note <i>Francesco Adamo</i> | 10 |
| 10.20373/2384-9398/60 | |
| Introduction <i>Maria Giuseppina Lucia, Monica Maglio and Francesca Rota</i> | 13 |
| 10.20373/2384-9398/61 | |
| <i>ARTICLES</i> | |
| Geopolitics of the energy transition: between global challenges and social justice <i>Simona Epasto</i> | 21 |
| 10.20373/2384-9398/62 | |
| Work across governance levels for just energy transitions – Juxtaposing findings from North and South <i>Späth Philipp Arifi Bleta, Haldar Stuti, Peddibhotla Ananya Bazaz Amir and Davies Megan</i> | 45 |
| 10.20373/2384-9398/63 | |
| A contextual understanding of just transitions in Uttar Pradesh’s brick industry <i>Harpreet Bhullar and Pooja Kini</i> | 63 |
| 10.20373/2384-9398/64 | |
| Regional expressions of the hydropower energy niche in Colombia <i>Masiel Melissa Pereira and Cesar Enrique Ortis-Guerrero</i> | 85 |
| 10.20373/2384-9398/65 | |
| The geographies of just transition. Understanding urban energy citizenship through a policy mobility approach <i>Giada Coleandro and Beatrice Ruggieri</i> | 113 |
| 10.20373/2384-9398/66 | |
| Planning green infrastructures for industrial cities: a territorial approach <i>Fabiana Fabri and Loïc Sauvée</i> | 131 |
| 10.20373/2384-9398/67 | |
| Nature-based solutions in Italian urban area for just transition <i>Monica Maglio, Concetta Riccio, Maria Giuseppina Lucia</i> | 147 |
| 10.20373/2384-9398/68 | |
| Framing the just transition objective in the context of periurban territorial development and planning. A literature review <i>Francesca Silvia Rota</i> | 171 |
| 10.20373/2384-9398/69 | |

Editorial Note

“Just Transition”, the theme of this special issue of the Journal—proposed by three Geoprogress members (Maria Giuseppina Lucia, Monica Maglio, and Francesca Silvia Rota), who edited the collection and wrote the Introduction—is a key concept in the debate on sustainable development at the global, national, subnational, and local levels. This transformation toward sustainable economies refers to the idea that the energy transition—toward a low-carbon economy—and, more generally, the ecological transition must take place in a fair and inclusive way, without leaving behind workers, vulnerable communities, and territories. This transition, in fact, must be both economic and social. It requires and entails profound and widespread economic, socio-cultural, and other systemic changes.

Deciding what is right and what is not is certainly highly subjective. However, several general concepts have been articulated on the subject, and the idea has been broadened to the point that today the notion of a transition that must be “globally” just seems to be gaining ground. This concept is not only an integral part of Geoprogress’ mission, but also a necessity for everyone. The unity of the terrestrial ecosystem, expressed by the circulation of water and air, is not the odd belief of some geographer but has become an established fact thanks to the development of natural sciences and techniques for detecting and measuring processes and elements of the geographical environment.

An initial concept of “just transition,” or one of the first, emerged within labor unions in advanced capitalist countries, especially in North America (notably the AFL-CIO in the 1980s and 1990s). These unions deserve credit for opening the debate and raising the necessary concern for protecting workers, aiming both to ensure a healthy environment—in factories and in the community—and to “protect jobs.” Yet, without business and economic development planning, this is akin to “saving both the goat and the cabbage,” and is almost impossible.

A second concept, nearly contemporary with the first and even preceding some NGO initiatives, was advanced by environmental movements in general, particularly those for climate justice (e.g., Climate Justice Alliance, Friends of the Earth), human rights, and concern for the impact of climate change on marginalized communities.

Development policies to combat poverty—rightly seen as one of the causes of the ecological crisis and, in any case, an obstacle to more ecologically sound development policies—but above all climate change initiatives, characterize the institutional approach to just transition by governments and supranational and international institutions (EU, OECD, UN, ILO). The concept is integrated into national climate plans, which appear to be, if not the only, then by far the primary institutional concern. A significant example is the European Green Deal, which provides a Just Transition Mechanism with funds for the regions most affected by decarbonization.

The global concept of a just transition, finally, begins with a consideration of inequalities between countries of the “North” and the “South,” both in terms of responsibility for the planet’s environmental degradation and the funds required for decarbonization and, more broadly, for less environmentally destructive growth. From Rio de Janeiro in 1992—or rather, from the establishment of the Global Facility at the World Bank, granted as a contribution by wealthy countries to support development initiatives in the Global South—to subsequent Conferences of the

Parties (COPs) under the United Nations Framework Convention on Climate Change (UNFCCC), Northern countries have made important commitments to support the countries of the Global South (poor and/or developing).

However, support for the ecological sustainability of their development—and for their economic growth and sustainability, without which the former would be meaningless—has always been framed as a donation, as an expression of the generosity of the North and specifically the West. Rarely has it been recognized as a necessity for the survival of the only planet we have, and therefore also for the North itself, and almost never as a legal, moral, and historical obligation or duty.

The notion that the transition is just only if it is global—and above all that it is up to the countries of the North to shoulder its financial burden, once the view of only a few scholars or minority groups—has gained ground over the past thirty years. This began with the December 1990 proposal—concurrent with the establishment of the Global Facility at the World Bank—to create an International Environmental Fund (IEF), intended as a compensation fund between environmentally indebted and environmentally creditor countries, a regulatory instrument for an international environmental system, and today also a means of coordinating the various specific funds created following several COPs. The IEF proposal, put forward at the conclusion of a seminar held in Belém do Pará—organized by the United Nations Science and Technology Agency, with the collaboration of the Government of Brazil—was endorsed by the United Nations Secretariat and presented at the Rio de Janeiro Conference, but the time and political context were not yet ripe for its adoption.

While not excluding donations among the funding sources—and indeed expressly including the “Global Facility” as the primary source of income and encouraging other possible contributions—the proposal was based on the assumption, finally recognized as a fundamental human right in the early 2020s, that every human being has the right to an equal share of clean air and other environmental conditions for existence and subsistence. From this fundamental human right, Geoprogess intends to relaunch the IEF proposal, first and foremost by updating it. To this end, it has issued a call for papers for a forthcoming special issue of the Journal on Sustainable Development Funds, and for a workshop to present and discuss research contributions useful for updating the proposal and transforming it into an operational project to be debated at a subsequent conference with institutions and all interested political parties. Referring readers to the call (see [geoprogess.eu/...](http://geoprogess.eu/)), I take this opportunity to invite them to participate—with their own contributions and by helping in various ways to raise public awareness in favour of at least the recognition of environmental credits and to promote behaviours that effectively reduce debt. Specifically, stakeholders should avoid bargaining over the global environment, allowing debtors to purchase credits with money, rather than inducing them (including through rewards, incentives, and taxes) to gradually reduce their debt. This is all the more necessary to enable economic growth in creditor countries, which, even with more sustainable techniques, will reduce their debts.

In this Special Issue on Just Transition, the global dimension and the specific ecological, economic, and social problems of the South are neglected, as are other issues, also from “a geographical perspective,” as the issue is titled. However, I can agree with the three aforementioned associates who curated the published articles when, in their Introduction to the issue, they write: “Although this special issue does

not cover all dimensions of the complex just transition debate, it provides meaningful insights into the geographical aspects of the ecological transition—especially with regard to social, economic, and environmental justice.” Indeed, it addresses aspects that remain important for “sustainable” development—which, ultimately, can only be an alternative to the current model.

Francesco Adamo

GEOPOLITICS OF THE ENERGY TRANSITION: CRITICAL RAW MATERIALS, GLOBAL ALLIANCES AND EMERGING INEQUALITIES

Simona Epasto*

Abstract

The global shift towards sustainable energy is reshaping geopolitical dynamics, introducing new vectors of influence centred on energy geopolitics. This research examines the intersections of energy transition strategies, environmental justice, and shifts in international power relations, focusing on key actors such as China, Russia, the European Union, and the United States. Highlighting concerns over critical raw materials, it underscores the urgency of diversifying sources and building resilient energy systems. The study emphasises the importance of integrating social justice into energy policies, advocating for inclusive international cooperation to ensure a transition that is both environmentally sustainable and socially equitable.

Keywords: Energy geopolitics, Social justice, International cooperation

1. Introduction

The geopolitics of energy emerged prominently on the global academic stage following the 1973–74 oil crisis, within the framework of what is termed neoclassical geopolitics (Mamadouh, 1998). As highlighted by Kuzembo et al. (2024), neoclassical attention was primarily focused on the positions and interests of developed countries, particularly their energy supply needs, geographic dependency, and spatial asymmetries, which foster forms of regional conflict (Bradshaw, 2009; Conant and Gold, 1978; Lizza, 2001; Lizza, 2011; Mitchell et al., 1996; Odell, 1974; Schlesinger, 1979; Yergin, 2012). Evidently, the energy mix required by Global North economies has increasing geopolitical and geoeconomic significance, influencing not only domestic policy decisions but also international relations and the conflicts shaping the geopolitical landscape after the Cold War.

From a spatial perspective, the geopolitics of energy outlines a highly differentiated geographical landscape and a persistent growth in not only asymmetries between the Global North and Global South but also dependency/dominance relationships across various scales of analysis. These relationships are tied not only to the localization of energy resources but also to exchanges and their transport routes. Blondeel et al. (2024) note that within the neoclassical paradigm, spatial factors are often treated as immutable, resulting in a deterministic view where geography, conceived statically, dominates international politics without reciprocal influence. This perspective, centred on cross-border fossil fuel flows and a “reified” conception of geography, coupled with the focus on state power politics, constitutes one of the main limitations of neoclassical energy geopolitics (Kuzembo et al., 2024). In recent years, studies have increasingly focused on renewable energy, to the extent that what Kuzembo et

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al. (2024) define as the geopolitics of renewable energy has become a growing field of study. This area has seen significant contributions from authors such as O’Sullivan, Overland, and Sandalow (2017), Scholten (2018), Scholten et al. (2020), Vakulchuk, Overland, and Scholten (2020), as well as studies by organisations like IRENA (2019). These studies often follow a recurring interpretative model, starting from the geotechnical properties of a renewable energy-based system to deduce constraints and opportunities that could influence international political dynamics. By comparing this with the current world, still reliant on non-renewable energy sources, potential changes and associated power dynamics are highlighted.

While offering valuable insights, these studies tend to overlook the transformative role of society in shaping energy systems, treating politics as a direct outcome of static energy and geographical configurations. This approach often neglects the complexity and transitional processes characterising the global energy system. Rather than focusing on an ideal future dominated by renewable energy, it is crucial to address the transition itself, which represents the real critical challenge for the coming decades. The way this transformation process is managed will determine whether and how a renewable energy system is achieved, requiring greater attention to the social, economic, and political factors that will shape its evolution (Kuzembo et al., 2024; Lizza, 2021).

This context frames the studies and political debates on decarbonisation and climate change mitigation that have engaged scholars, analysts, and international organisations over the past decades. As highlighted by Strambo (2020), the principle emphasises the importance of equitably distributing the benefits and costs of the transition to a low-carbon economy, with particular attention to supporting workers and communities most affected by the abandonment of fossil fuels (Strambo, 2020; Gass et al., 2018; Healy and Barry, 2017).

Traditionally, research and policies on energy transitions have focused on innovation in new industries, technologies, and behaviours, often neglecting the need to address the decline of established industries (Fouquet and Pearson, 2012). However, there is a growing awareness that addressing climate change also requires planned management of disinvestment from high-carbon activities (Bridge et al., 2013) and fossil fuel production (Green and Denniss, 2018; Lazarus and van Asselt, 2018). The concept of a just transition, therefore, highlights those regions affected by reductions in high-impact sectors, identifying them as key areas for policy interventions aimed at decarbonisation.

At the heart of this vision lies the need to ensure an equitable distribution of the burdens and benefits of decarbonisation, both among countries and within their societies. Recent debates, including those at the COP 29 in Baku in November 2024 (UN, 2024), fit within this perspective. Discussions on the Just Transition Programme have been intense, with Global South countries demanding greater financial support and respect for the principle of differentiated responsibilities. The divergences primarily concerned the scope of application: while Northern countries favoured national policies, Southern countries advocated for an international and cooperative approach to protect vulnerable states and include human rights considerations.

The global transition to a sustainable economy is also redefining power dynamics in the global geopolitical landscape, introducing new vectors of influence that reflect the growing importance of energy geopolitics (IRENA, 2023). This is a critical

geopolitical and geoeconomic challenge, fostering evolving scenarios of competition and cooperation. It is a challenge that requires not only a rebalancing of economic and trade systems but also synergy between energy transition strategies, environmental justice, and shifts in international power relations.

This research focuses on how a fair energy transition is reshaping global alliances and spheres of influence, with particular attention to key geopolitical actors such as Russia, China, the European Union, and the United States (IRENA, 2023b). The growing concern over reliance on critical raw materials, especially from China, underscores the urgency of diversifying sources and developing resilient energy systems at both national and international levels (Borrell, 2023; EEAS, 2023). Russia's ambivalent role as both a major hydrocarbon supplier and a key element in European energy security is highlighted, particularly considering the Ukraine invasion, which has intensified tensions in the energy sector and pushed Europe toward more sustainable alternatives (Mabon, 2023; Skalamera, 2023).

Moreover, the study examines how energy geopolitics is influenced by and, in turn, influences global and regional events, including conflicts and international tensions, shaping energy transition strategies and diplomatic relations. It underscores the necessity of a holistic approach that integrates geopolitics into energy discussions, highlighting how global dynamics are shaping progress toward sustainable energy goals (Hammelehle, 2023; Foreign Affairs, 2023; Stevis and Felli, 2020; Stark, 2023).

The research also emphasises the importance of incorporating social and economic justice considerations into energy transition planning to prevent exacerbating existing inequalities and to ensure an equitable distribution of the benefits of sustainable development. It advocates for a cooperative and inclusive approach to energy policies to promote shared sustainable development and prevent the risks of new energy colonialism (Patel, 2023; Strambo, 2023; Heffron and McCauley, 2018; Weller, 2019).

In conclusion, the study reaffirms the urgency of integrating social justice and geopolitical considerations into energy transition policies, stressing the need for inclusive international dialogue and a renewed commitment to robust international cooperation. Such cooperation should aim to overcome the challenges of the energy transition fairly, considering the historical responsibilities and economic capacities of different countries, to ensure a transition to a low-carbon future that is not only environmentally sustainable but also socially just and inclusive.

2. Methodological Framework

The theoretical approach begins with the geopolitical framework for analysing power dynamics and international influence, followed by an examination of institutional reports (e.g., IRENA, EEAS) and relevant scientific literature. This is complemented by a comparative case study analysis (e.g., the European Green Deal, the U.S. Inflation Reduction Act), supported by an interdisciplinary perspective integrating economic and political geography.

Specifically, the geopolitical research methodology adopts a structured, interdisciplinary geopolitical approach designed to examine the global energy transition dynamics in relation to interactions between power, space, and social justice (Cohen, 1963; Hartshorne, 1991). The methodology is structured into four

key phases: definition of spaces and actors; evaluation of factors; analysis of interconnections; and a meta-geopolitical approach.

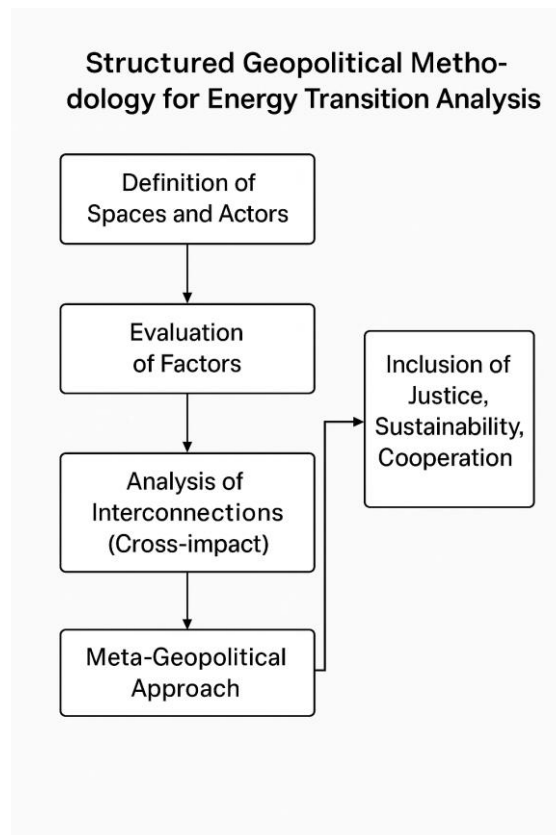


Figure 1: Methodological Framework for Analysing Energy Transition Dynamics. Source: Elaboration by the author developed with theoretical and methodological references. Diagram created using Python (Matplotlib).

2.1 Definition of Spaces and Actors

The first phase involves delimiting relevant geopolitical spaces for energy and identifying key actors. This step relies on a dynamic vision of spaces of interest, influence, and action (Jean, 2003; Santoro, 1991).

The actors considered include:

- National governments: such as China (a leading supplier of critical raw materials) and Russia (a hydrocarbon supplier and ambivalent geopolitical actor).
- International organisations: such as IRENA and EEAS.
- Private actors: including energy multinationals and tech start-ups developing sustainable energy infrastructures.

2.2 Evaluation of Factors

This phase analyses the critical factors influencing the geopolitics of energy transition (Celerièr, 1969; Jean, 2003). The evaluation is based on a relational approach, considering the interdependence of various elements:

- Access to resources: availability, control, and dependence on critical raw materials.
- Energy technologies: impact of technological innovations on power distribution and productive capacities.
- Environmental and economic factors: effects of climate change and mitigation policies on national and regional economies.
- Security factors: geopolitical stability and risks associated with competition over scarce resources.

This analysis requires the integration of expertise from various disciplines, such as economic geography, political science, and environmental sustainability.

2.3 Analysis of Interconnections

The next phase explores the interactions between actors and factors using the cross-impact technique (Jean, 2003; Antonsich, 1995). This methodology helps identify:

- Dynamic relationships between geopolitical actors (e.g., EU-China competition for control of battery supply chains).
- Risks and opportunities arising from energy transition strategies, such as reducing European energy dependency on Russia through renewables.
- This qualitative approach, more flexible than quantitative models like game theory, captures the complexity of strategic decisions and their long-term consequences.

2.4 Meta-Geopolitical Approach

At the core of the analysis is a meta-geopolitical framework that incorporates the values of environmental and social justice as guiding principles for strategic priorities. This phase ensures:

- Constant attention to the social and economic implications of energy policies, preventing the creation of new inequalities.
- Integration of inclusion and international cooperation principles to promote a sustainable and shared energy future.

This methodology does not merely describe geopolitical dynamics but places them in a normative and strategic context, aiming to identify policies and solutions that effectively balance the needs for environmental sustainability and social justice.

3. Pioneering Policies and Leadership in the Energy Transition

Pioneering policies such as the European Green Deal and the United States' Inflation Reduction Act (IRA) represent a paradigm shift in the governance of the energy

transition. Both serve as examples of strategic leadership in an era of escalating geopolitical competition and urgent decarbonisation needs. These policy instruments not only aim to reduce greenhouse gas emissions but also redefine the role of advanced economies in shaping a new global energy order.

The European Green Deal seeks to make the EU climate-neutral by 2050, placing strategic autonomy and social justice at its core. The initiative includes the Just Transition Mechanism, designed to support regions most affected by the transition through targeted investments and economic assistance, thereby reducing regional inequalities (European Commission, 2023; Bazilian et al., 2019). However, this ambition faces challenges such as new dependencies, particularly on rare earth elements and technologies imported from countries like China, raising concerns about long-term geopolitical sustainability (Blondeel et al., 2021; Herranz-Surrallés, 2024). Furthermore, the Green Deal has been criticised as a potential form of "green protectionism" that could destabilise international trade, requiring a delicate balance between national interests and global equity (EEAS, 2023).

The U.S. Inflation Reduction Act, passed in 2022, marks a turning point in American climate policy. With an investment of \$370 billion, the legislation aims to cut emissions by 40% by 2030 relative to 2005 levels, promote the adoption of green technologies, and strengthen domestic industrial competitiveness (PBS News, 2022). The IRA offers substantial financial incentives for renewable energy production and installation, electric vehicles, and advanced energy infrastructure, aiming to build a resilient industrial base (Forbes, 2023). However, political compromises, including continued support for fossil fuel projects, raise questions about the act's effectiveness as a global model for a fair transition (Climate Group, 2023).

These pioneering policies do not operate in a geopolitical vacuum but reflect the increasing "geopoliticisation" of energy issues. The ecological transition is becoming a cornerstone of global power strategies, with the United States, China, and Europe competing for control over critical resources and green technologies (Lizza, 2024; Blondeel et al., 2021). The competition for leadership in strategic sectors such as green hydrogen and battery materials is fostering new alliances and international frictions, underscoring the centrality of energy policy in global relations (Goldthau et al., 2019; Bazilian et al., 2019).

For these reasons, following the chosen methodological approach, the next section will focus on defining spaces and actors, particularly those identified as key geopolitical players in the energy transition.

4. Key Geopolitical Actors in the Energy Transition

The European Green Deal and the Inflation Reduction Act represent not only decarbonisation strategies but also instruments of geopolitical transformation. Both propose visions of international leadership that aim to balance economic growth, environmental sustainability, and social cohesion. However, their success will depend on the ability to overcome challenges related to social justice, technological inequalities, and geopolitical competition for resources (Herranz-Surrallés, 2024; European Commission, 2023; Vakulchuk et al., 2020).

As previously mentioned, the global energy transition is redefining geopolitical dynamics through competition for control of critical resources, diversification of energy sources, and the consolidation of new alliances. Key actors such as China,

Russia, the United States, the European Union, and international organisations play crucial roles in this complex scenario.

4.1 China: Global Dependence and Control of Critical Raw Materials

China holds a dominant position in the global supply chain of critical raw materials, such as rare earth elements, lithium, and cobalt, which are fundamental for the energy transition and renewable technologies. The country controls approximately 60% of global rare earth processing and most of the lithium and cobalt refining, making it an indispensable player in the production of batteries, wind turbines, and solar panels (UNDP, 2023; USGS, 2022; IRENA, 2023; Lizza, 2024; Shen et al., 2020). This concentration of resources gives China significant geopolitical leverage, as many countries rely on its exports to meet the growing demand for green energy.

China's centrality in the critical raw materials market is not only a result of the availability of natural resources but also of aggressive industrial policies and targeted investments in the development of processing and refining infrastructure. Through programmes like *Made in China 2025*, the Chinese government has consolidated its technological leadership in strategic sectors, increasing its global influence. However, this dominant position has raised significant international concerns, especially among Western countries, which perceive dependence on China as a strategic vulnerability (IRENA, 2024).

Rising geopolitical tensions have prompted many nations, including the United States and the European Union, to diversify their supply chains. These efforts include investments in local mining projects, trade agreements with resource-rich countries such as Australia and Chile, and the development of recycling technologies for critical raw materials. Additionally, initiatives like the EU's *Critical Raw Materials Act* and the US-led *Minerals Security Partnership* aim to reduce reliance on a single supplier, mitigating risks associated with market disruptions or potential geopolitical conflicts (IRENA, 2023).

Despite these countermeasures, China continues to maintain a competitive advantage due to its ability to integrate resource control with robust industrial infrastructure and a specialised workforce. Furthermore, the country is expanding its influence through strategic investments in Africa and Latin America, where significant reserves of critical raw materials are located. Such operations not only strengthen China's economic position but also consolidate its role as a global leader in the energy transition (UNDP, 2023).

The geopolitical implications of global dependence on China are significant. On the one hand, they reinforce China's role as an indispensable actor in the energy transition; on the other hand, they increase international tensions, as other countries seek to reduce their exposure to a system dominated by a single nation. This scenario highlights the need for a multilateral approach to ensure a fair and sustainable energy transition, minimising risks associated with resource concentration and promoting broader global cooperation (IRENA, 2024).

4.2 Russia: An Ambivalent Role in European Energy Security

Russia has historically been a key player in the global energy market due to its vast reserves of oil and natural gas, exercising significant geopolitical influence through hydrocarbon exports. However, the invasion of Ukraine in 2022 marked a critical

turning point, transforming Europe's energy dependence on Russia into a strategic vulnerability. This accelerated the European Union's disengagement from Russian supplies, leading to a rapid diversification of energy sources and increased investments in renewable energy and liquefied natural gas (LNG) infrastructure (Skalamera, 2023; Lizza, 2024).

In response to Western sanctions and reduced European demand, Moscow sought to shift its focus toward new markets, strengthening ties with emerging economies such as China and India. Energy cooperation with China has been particularly significant, with increased gas exports through pipelines like *Power of Siberia* and negotiations for new agreements to expand infrastructure (IRENA, 2023). At the same time, India has become a major importer of Russian oil, taking advantage of significant discounts offered by Moscow to compensate for the loss of Western markets.

Despite these adjustments, Russia's position in the global energy market is undergoing structural erosion. The global energy transition, with the gradual phasing out of fossil fuels, represents a long-term threat to an economy heavily reliant on hydrocarbon exports (European Bank for Reconstruction and Development, 2023). Additionally, growing geopolitical competition has prompted many countries to reduce their exposure to Russian supplies, favouring the development of renewable energy projects and energy storage infrastructure (IRENA, 2024; Munich Security Conference, 2021).

Russia's ambivalent role also manifests in its capacity to destabilise global energy markets. Events such as the sabotage of the Nord Stream 1 and 2 pipelines in 2022 highlighted the vulnerability of critical energy infrastructure within the context of geopolitical conflicts (Lizza, 2024). These incidents have reinforced the EU's determination to diversify energy sources and invest in more resilient solutions, such as decentralised energy networks based on renewables.

Despite these challenges, Russia continues to leverage its energy resources as a tool of foreign policy. Moscow's strategy involves not only maintaining exports but also strengthening bilateral relations with non-Western countries, aiming to build new alliances in response to Western-imposed isolation. However, Russia's ability to sustain this position will depend on its capacity to adapt to a rapidly changing global energy landscape characterised by decarbonisation and increasing focus on supply security (Skalamera, 2023; IRENA, 2024).

In conclusion, Russia's role in European and global energy security is evolving. While Europe's disengagement represents a significant challenge, Moscow is attempting to reorient its strategies to remain relevant in the new global energy order. However, dependence on an economy centred on hydrocarbons and ongoing geopolitical tensions could limit Russia's ability to successfully adapt to the structural changes brought by the energy transition (IRENA, 2024; Lizza, 2024).

4.3 European Union and United States: Cooperation and Competition

The European Union and the United States share common goals in combating climate change and promoting a sustainable energy transition, but they differ significantly in the strategies adopted to achieve them. The European Green Deal represents an ambitious and integrated plan that emphasises sustainability, social justice, and the reduction of regional inequalities through mechanisms such as the *Just Transition Mechanism*. In contrast, the US Inflation Reduction Act focuses on tax incentives and targeted subsidies to stimulate domestic green technology

production and strengthen industrial competitiveness, reflecting a market-oriented and economic sovereignty approach (European Commission, 2023; IRENA, 2024). These divergent approaches reflect not only structural differences in the two blocs' economies but also varying political and cultural priorities.

The EU seeks to balance climate goals with social and territorial cohesion, addressing internal challenges such as the decarbonisation of its Member States' economies that are more reliant on fossil fuels, particularly in Central and Eastern Europe. Poland and Hungary have shown increasing opposition to EU initiatives aimed at raising decarbonisation targets (Ćetković and Buzogány, 2019). In Poland, this resistance is mainly tied to the historical importance of the coal industry, considered crucial for national energy security and heavily influenced by state participation in key sector companies (Schwartzkopff and Schulz, 2017). From a geopolitical perspective, Hungary's stance is notable: its government has assigned low priority to energy and climate issues, choosing instead to support Poland's position in exchange for reciprocal backing on other matters, such as migration and the rule of law (Schulz et al., 2017). This strategic alignment led, for instance, to the coalition of these two states with the Czech Republic and Estonia during the 2019 EU summit, to remove references to achieving climate neutrality by 2050 (Morgan, 2019; Strambo, 2020).

The United States, on the other hand, focuses on a model driven by technological innovation and private investments, aiming to strengthen its global leadership in renewable energy and advanced technologies such as batteries and green hydrogen (Munich Security Conference, 2021; IRENA, 2024).

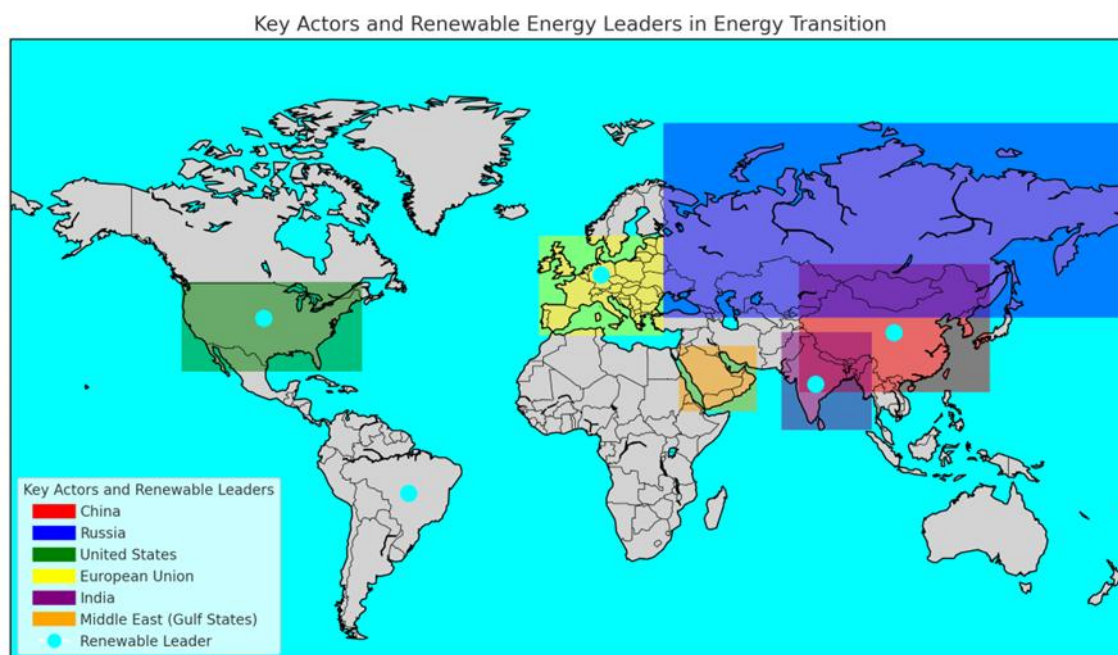
Despite these differences, there are significant opportunities for transatlantic cooperation. Developing infrastructure for green hydrogen and creating international standards for clean technologies are promising areas for collaboration. Both blocs are also investing in smart grids and digitalisation of the energy sector, offering potential synergies to improve energy efficiency and the resilience of critical infrastructure (IRENA, 2024).

However, competition for industrial leadership is a tangible reality. The IRA, with its generous subsidies, has raised concerns within the EU about the potential relocation of investments and production to the United States, threatening Europe's green industry and fuelling trade tensions (European Commission, 2023).

Adding to these dynamics is the growing importance of critical raw material supply chains, where both blocs seek to reduce dependence on China. Both the EU and the United States are investing in projects to diversify supplies and develop recycling capabilities, but competition for access to limited resources could intensify. For instance, the European *Critical Raw Materials Act* and the US-led *Minerals Security Partnership* illustrate parallel but not necessarily coordinated efforts to address this challenge (IRENA, 2023; Munich Security Conference, 2021).

The relationship between the European Union and the United States in the energy transition is thus characterised by a delicate balance between cooperation and competition. While they share the common goal of a low-carbon future, their structural and strategic differences create frictions that could hinder the formation of a united front against global climate challenges. Nevertheless, the urgency of the climate crisis may push the two blocs to strengthen their collaboration, especially in strategic areas such as technological innovation, green hydrogen, and supply chain resilience (IRENA, 2024).

The following map provides an overview of the key geopolitical actors and renewable energy leaders in the global energy transition. It highlights their spheres of influence and regional leadership in shaping the future of sustainable energy systems:



*Figure 2: Key Actors and Renewable Energy Leaders in Energy Transition.
Source: Elaboration by the Author using Python and AI tools*

4.4 International Organisations: Coordination and Support Role

International organisations play an essential role in facilitating the global energy transition, promoting multilateral cooperation, and addressing systemic challenges related to energy and climate security. Among these, the International Renewable Energy Agency (IRENA) and the European External Action Service (EEAS) are key actors contributing to strategy development, action coordination, and ensuring an inclusive approach to decarbonisation.

4.4.1 IRENA: Promoting Global Energy Justice

IRENA stands out as a global forum for the adoption of sustainable energy policies and the development of renewable energy (IRENA, 2024b; IRENA, 2024c). The organisation emphasises the importance of strengthening the resilience of critical raw material supply chains, often subject to disruptions caused by geopolitical conflicts or natural disasters. IRENA supports initiatives aimed at diversifying supply sources and developing industrial capacities in developing countries, thereby contributing to global energy justice (IRENA, 2023). Additionally, the agency promotes investments in renewable technologies, such as solar, wind, and green hydrogen, stressing the urgency of establishing shared international standards to accelerate the transition (IRENA, 2024).

4.4.2 EEAS: The Geopolitical Dimension of Energy.

The EEAS guides the European Union's external action in the energy sector, strengthening relationships with strategic partners and supporting active climate diplomacy. This role is particularly crucial in the context of growing geopolitical competition, where the EU aims to reduce energy dependence on actors like Russia and China, diversify its sources, and reinforce transport and storage infrastructure (Lizza, 2024). The EEAS also works to integrate climate and environmental dimensions into the EU's external relations, collaborating with multilateral organisations such as the United Nations and the G7 to promote coordinated and ambitious policies globally.

4.4.3 The Role of COP and Other Multilateral Institutions.

Beyond IRENA and the EEAS, the Conferences of the Parties (COP) under the United Nations Framework Convention on Climate Change (UNFCCC) represent a pivotal moment for defining global objectives. These annual summits, despite their complex negotiations, have the merit of maintaining focus on the climate emergency and encouraging the adoption of binding commitments. However, the lack of effective enforcement mechanisms and the divergences between developed and emerging countries often limit the impact of the agreements reached (Lizza, 2024).

4.5 Synergies and Challenges for the Future

International organisations face growing challenges in managing the dynamics of the energy transition. Increasing geopolitical polarisation, rising trade tensions, and economic inequalities make it difficult to coordinate coherent global actions. However, initiatives such as the Green Climate Fund and the Global Environment Facility demonstrate the potential of international partnerships to mobilise financial resources and support the most vulnerable countries in the decarbonisation process (IRENA, 2023). At the same time, cooperation between organisations like IRENA and EEAS can help overcome structural challenges, promoting a transition model that balances economic growth, social justice, and environmental sustainability. International organisations are a fundamental pillar for the global coordination of the energy transition. Strengthening multilateral dialogue, promoting inclusive policies, and addressing geopolitical tensions will be key to ensuring a sustainable and resilient energy future.

In this context, it can be argued that the global energy transition represents a field of both competition and collaboration among key actors. While China and Russia consolidate their influence over the control of critical resources, the European Union and the United States strive to establish global standards for a sustainable future. International organisations, therefore, remain essential to mitigating tensions and fostering effective cooperation in an increasingly complex geopolitical landscape.

5. Defining Spaces in Relation to Actors

The global energy transition is redefining not only the role of key actors involved but also the geopolitical spaces of reference. The delineation of relevant spaces is based on a dynamic framework, which includes, for illustrative purposes and without aiming for exhaustiveness, three main categories: zones of interest, zones of

influence, and zones of action. This classification can help better understand the interactions between global powers and strategic regions in the context of energy security and critical raw materials.

5.1 Zones of Interest

Zones of interest comprise regions rich in natural resources essential for emerging energy technologies, such as lithium, cobalt, and rare earth elements. These resources, critical to produce batteries and wind turbines, are primarily located in countries like Chile, Australia, the Democratic Republic of Congo, and China. The growing global demand for these raw materials has made such regions central to geopolitical competition. For example, China not only holds a dominant position in rare earth processing but also invests in mines across Africa and Latin America, further strengthening its global influence (IRENA, 2023; Lizza, 2024).

5.2 Zones of Influence

Zones of influence include strategic areas for international trade and economic relations. For the European Union, Africa is a key region for economic and energy cooperation, owing to its natural gas reserves and opportunities for renewable energy development. Similarly, the United States views Latin America as a crucial partner for diversifying supply chains and countering China's influence in the region (Munich Security Conference, 2021). These spaces reflect the increasing competition to consolidate strategic alliances and control trade routes vital to global energy security.

5.3 Zones of Action

Zones of action are spaces where global powers directly compete for control of resources or energy infrastructure. Ukraine serves as a striking example, being a critical point for European energy security. The conflict with Russia has exacerbated geopolitical tensions, highlighting the vulnerability of traditional energy infrastructure and accelerating European investment in renewable and alternative solutions (Skalamera, 2023). Other relevant spaces include the South China Sea, where China is reinforcing its presence to control energy routes, and the Arctic, where competition for natural resources among major global powers is intensifying (Dodds and Woodward, 2021; IRENA, 2024).

The map below illustrates the primary geopolitical zones relevant to the energy transition. It identifies areas of interest, influence, and action, highlighting strategic regions critical for resource availability, infrastructure, and global energy security:

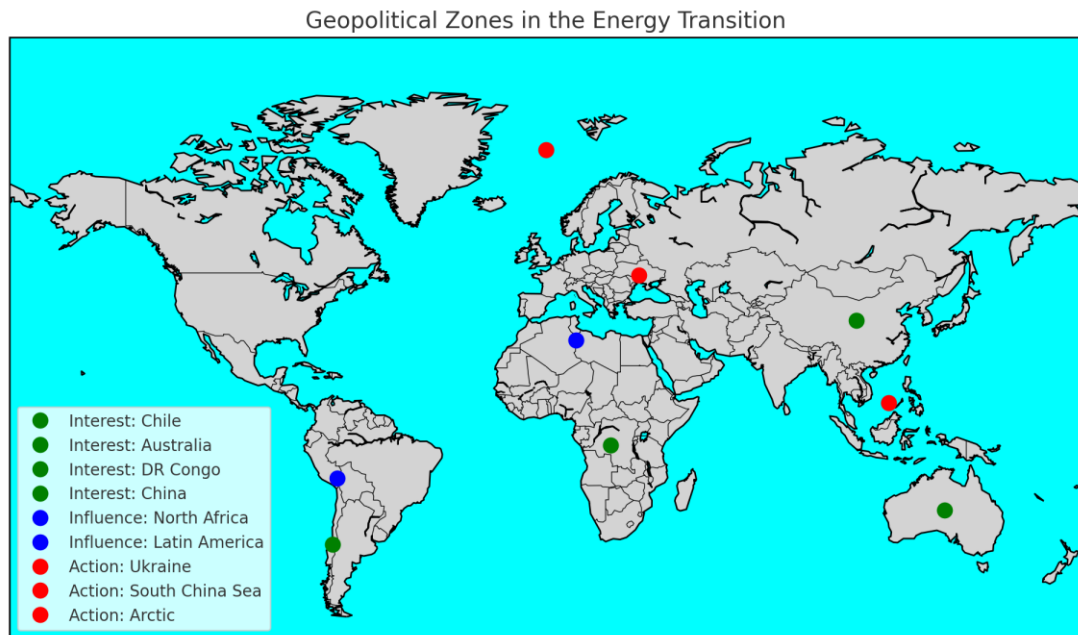


Figure 3: Geopolitical Methodological Framework for Analysing Energy Transition Dynamics.

Source: Elaboration by the Author using Python and AI tools.

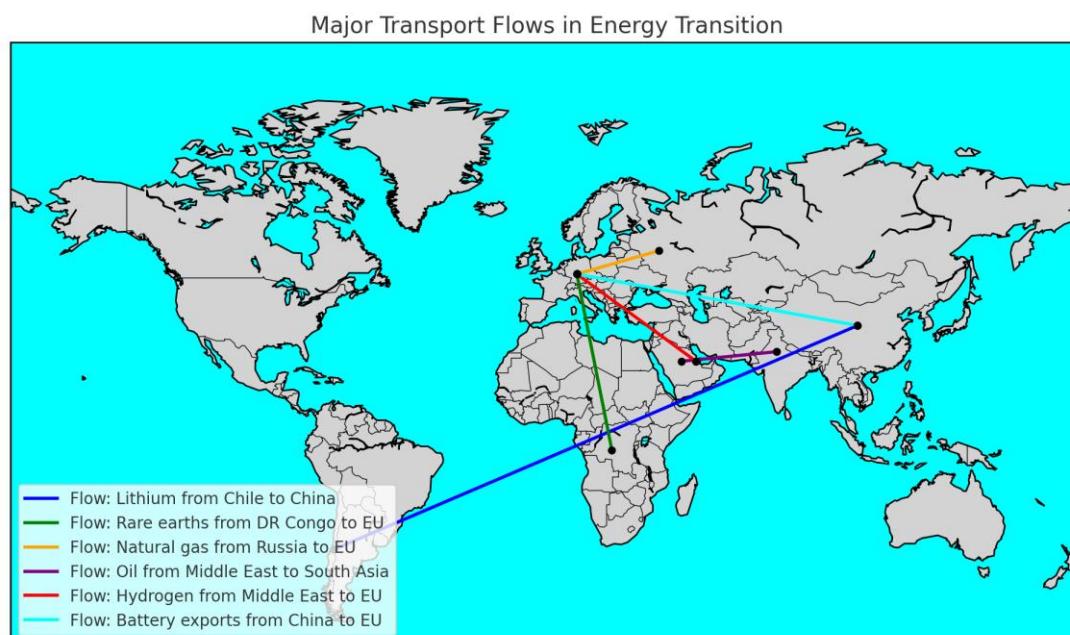
The definition of geopolitical spaces and the identification of key actors represent a fundamental step in understanding the dynamics of the energy transition. Interactions between zones of interest, influence, and action shape the global geopolitical landscape, underscoring the urgency of coordinated policies to address challenges related to energy security and sustainability.

The following section will analyse these dynamics in relation to the determining factors influencing the geopolitics of the energy transition, exploring the interactions between actors and factors through cross-impact analysis.

6. Key Determinants and Interconnections in the Energy Transition

The global energy transition evolves through the interplay of structural factors that profoundly influence the geopolitical landscape and the strategies of international actors. Among these, the control and availability of critical resources represent a pivotal aspect: lithium, cobalt, and rare earth elements are essential for advanced technologies such as batteries and wind turbines. The geographic concentration of these resources, coupled with growing competition for their control, highlights systemic vulnerabilities, driving efforts to diversify supply chains (IRENA, 2023).

This map represents the major transport flows of critical resources essential to the energy transition, such as lithium, rare earths, and hydrogen. It visualises the interconnections between production regions and consumer markets, underscoring the strategic dependencies shaping global supply chains:



*Figure 4: Major Transport Flows in Energy Transition.
Source: Elaboration by the Author using Python and AI tools.*

Technological innovation is another central element. The development of advanced energy technologies, such as green hydrogen and smart grids, is reshaping global power relations. These advancements not only enhance production capacity but also reduce dependence on traditional resources, offering technologically advanced actors a strategic advantage. This phenomenon underscores the need for multilateral governance to prevent the consolidation of technological monopolies (IRENA, 2024).

The environmental and economic dimensions of the energy transition present significant challenges and opportunities. The costs of decarbonisation vary greatly among economies, potentially creating inequalities between the Global North and South. However, climate policies can also promote economic resilience, transforming historically marginalised regions into hubs for renewable energy. Africa, for instance, is emerging as a key partner for Europe, with the potential to reduce external energy dependence and foster sustainable growth (Lizza, 2024).

Energy security remains a crucial issue, shaped by geopolitical events such as the war in Ukraine. These conflicts have demonstrated the urgency of building resilient infrastructure capable of withstanding market disruptions or political pressures. However, the interaction between energy security and ecological transition requires a delicate balance to avoid new strategic dependencies emerging in critical sectors such as batteries (Skalamera, 2023).

The interconnections among these factors amplify the complexity of the energy transition, revealing both risks and opportunities. Geopolitical competition, such as the rivalry between the EU and China over supply chain control, intersects with strategic alliances, such as the strengthening of ties between Russia and China. This context creates a dynamic scenario in which national strategies directly influence global prospects. At the same time, opportunities such as reducing energy

dependence on Russia through renewables and hydrogen, or developing smart grids, provide pathways toward greater geopolitical stability (IRENA, 2024).

In summary, the success of the energy transition will depend on the ability to harmonise key determinants with collaborative strategies. While competition over resources, technologies, and energy security persists, coordinated efforts can mitigate risks and promote a sustainable, resilient, and inclusive future (Munich Security Conference, 2021).

7. Social Justice in the Energy Transition: Challenges and Prospects

Despite the energy transition representing a unique opportunity to build a more sustainable future, its social and economic implications raise critical questions.

The necessity to phase out fossil fuels and adopt renewable energy sources may create new inequalities, exacerbating existing ones if targeted policies are not implemented. Communities reliant on carbon-intensive industries risk facing economic decline, while regions rich in critical resources such as lithium and cobalt could experience exploitation and instability (Newell, 2023; IRENA, 2024).

An emerging issue is the risk of "energy neo-colonialism," where growing demand for critical raw materials intensifies pressure on regions in the Global South. Countries such as the Democratic Republic of Congo and Chile face the paradox of the "resource curse": despite being resource-rich, economic benefits often concentrate in the hands of local elites or foreign multinationals, leaving local communities exposed to negative environmental and social impacts. This model perpetuates historical inequalities between the Global North and South, underscoring the urgent need for structural changes to ensure a fair distribution of economic benefits (IRENA, 2023; EEAS, 2023).

To counter these dynamics, it is essential to adopt cooperative strategies that promote distributive and procedural justice. An inclusive approach should strengthen local capacities through technology transfers and worker training programmes while investing in sustainable infrastructure that actively involves local communities in decision-making processes. For example, policies aimed at developing a specialised workforce in renewable energy can mitigate the impacts of the transition in areas affected by the closure of fossil industries, ensuring opportunities for shared economic growth (Just Transition Report, 2022; Newell, 2023).

However, the interpretation of the concept of Just Transition (JT) can lead to paradoxical outcomes. In South Africa, for instance, the National Union of Metalworkers of South Africa (NUMSA) used the concept of JT to legally prevent the state electricity company from signing renewable energy contracts with independent power producers. The union argued that such contracts would lead to the loss of tens of thousands of coal sector jobs and higher electricity prices, harming the working class (Cock, 2018; Strambo, 2020).

For these reasons, the economic and social implications of the energy transition also call for global governance that integrates social justice considerations at every stage of the decision-making process. Organisations like IRENA and UNDP play a central role in defining standards for fair labour practices and the adoption of sustainable measures to prevent new forms of inequality. Locally, partnerships between the Global North and South must promote a rebalancing of power dynamics, transforming resource-rich regions into hubs of innovation and development. This inclusive approach not only addresses the immediate needs of the transition but also

contributes to building a more equitable and resilient global economic system (IRENA, 2024; Newell, 2023).

Integrating social justice into energy policies is an imperative to ensure that the energy transition does not become a source of new divisions.

Investing in an inclusive and collaborative approach offers the possibility of transforming a global challenge into a lever for justice and sustainability. Only through strategic planning that considers economic and social impacts can an equitable and inclusive energy future be ensured for all communities, regardless of their geographic location or economic condition (Newell, 2023; Just Transition Report, 2022).

8. Geopolitics of the Energy Transition and Future Scenarios

The energy transition is profoundly transforming global geopolitical dynamics, revealing both new tensions and potential avenues for cooperation. The war in Ukraine has accelerated Europe's detachment from Russian gas, exposing the vulnerability of fossil-based supply chains and reinforcing the urgency of investment in renewable and decentralised infrastructures (Skalamera, 2023; IRENA, 2023). Similarly, rising tensions around Taiwan have highlighted the strategic fragility of supply chains for critical technologies such as batteries and semiconductors (EEAS, 2023).

The Middle East, historically central to fossil fuel geopolitics, is repositioning itself through major investments in green hydrogen and solar power, especially in Gulf states. However, the region remains highly exposed to conflict and instability. The Israeli-Palestinian escalation and rivalry among regional powers such as Saudi Arabia, Iran, and Turkey complicate the political conditions necessary to support energy cooperation and infrastructural investment (Mabon, 2024; IRENA, 2023).

Future geopolitical scenarios oscillate between inclusive multilateralism and resource-driven competition. On one hand, the transition may foster new North–South partnerships, as international organisations such as IRENA and EEAS promote inclusive governance, financial support, and the development of shared standards (IRENA, 2024; EEAS, 2023). On the other, the intensification of energy nationalism and strategic rivalries over critical raw materials - such as China's dominance in rare earths and Arctic competition - could aggravate geopolitical fragmentation (Dodds and Woodward, 2021; Newell, 2023).

In this evolving context, international organisations emerge as key actors. IRENA's emphasis on climate justice and supply chain resilience, and the EEAS's diplomatic role in shaping EU external energy policy, are essential to mediate between diverging state interests and avoid the instrumentalisation of environmental agendas for strategic ends (IRENA, 2024; EEAS, 2023).

The geopolitics of the energy transition is already redrawing global power relations. Its success will depend on our collective ability to reconcile energy security, environmental sustainability, and social justice within a renewed framework of multilateral governance (Newell, 2023; IRENA, 2023).

8. Conclusion

The global energy system is undergoing profound transformations that will affect nearly all states, generating significant geopolitical implications. Renewable energy

sources have taken a central position in the global energy landscape, thanks to technological advances and cost reductions that have accelerated their growth, surpassing all other energy sources. Today, many renewable technologies are economically competitive with fossil fuels, even without considering their crucial role in combating air pollution and climate change.

These dynamics are driving an irreversible process of global energy transition. Although the expansion of renewables, such as wind and solar, initially focused primarily on the electricity sector, technological advancements are extending this transformation to other domains. Electric vehicles and heat pumps are integrating renewables into transport, industry, and construction, while innovations in digitalisation and energy storage are expanding their possibilities in ways unimaginable just a few years ago (Global Commission on the Geopolitics of Energy Transformation, 2019).

The acceleration in renewable energy adoption is driving a global energy revolution with significant geopolitical implications. Just as fossil fuels determined geopolitical balances over the past two centuries, this transition will reshape the global distribution of power, international relations, conflict risks, and the social, economic, and environmental factors contributing to geopolitical instability.

While the geographic concentration of fossil fuel reserves significantly shaped the international geopolitical landscape in the 19th century and control over production and trade did so in the 20th century, the transition to renewables could transform global power relations and is already doing so to some extent.

Regarding the actors involved, China and Russia have focused on delaying the energy transition through strategic foreign policies aimed at compensating for reduced demand in Europe. Both powers have turned to the Central Asian market through investments, new infrastructure, and memoranda of understanding. However, the positions of these two states diverge in relation to the ongoing changes. While China stands to benefit from the transition, Russia's position is more precarious. China is a leader in renewable energy production, technological innovation, and investment. Conversely, despite having a diversified economy, Russia continues to rely on fossil fuel revenues for approximately 40% of its state budget (IEA, 2024). Despite its investments in clean energy, Russia is significantly overshadowed by China.

The main global actor across the ocean has nearly achieved energy self-sufficiency thanks to its shale gas reserves. Additionally, the United States holds a leadership position in clean energy thanks to its technological firms and innovations. Conversely, the EU and Japan remain significantly dependent on fossil fuel imports but have substantial positions in the development of renewable energy technologies. As highlighted by IRENA (Global Commission on the Geopolitics of Energy Transformation, 2019), Germany leads in renewable energy patents, making it a pioneer in the large-scale adoption of renewable energy sources.

Geographically and with respect to geopolitical dynamics related to the just transition, other regions offer a diverse mapping. The Middle East and Maghreb regions, like Russia and Gulf states, are particularly vulnerable to declining fossil fuel revenues. This contraction could undermine economic growth prospects and strain national budgets, necessitating economic restructuring to reduce fossil fuel dependency and diversify economies to avoid economic crises.

On the other hand, sub-Saharan Africa, excluding Nigeria and Angola, which remain heavily dependent on oil exports, could benefit from reduced fossil fuel imports and the local development of renewable energy, promoting economic growth and creating new jobs. In South Asia, the energy transition could significantly reduce the rising costs associated with increasing energy demand.

Overall, North America and Latin America are largely energy neutral, thanks to a balance between domestic resources and international energy trade. However, countries that have historically exerted geopolitical influence as fossil fuel suppliers risk losing their global standing if they fail to reinvent their economies to adapt to the new energy paradigm. Many of these countries have used fossil fuel revenues to finance socioeconomic development, strengthen military capabilities, and invest in foreign assets. However, the global energy transformation, by exerting downward pressure on fossil fuel prices and revenues, could threaten the stability of economies that have not adequately prepared for this shift.

The loss of oil revenues, particularly in countries with weak governance, could lead to severe political and social instability. A historical example is the collapse in oil prices during the 1980s, which significantly contributed to the fall of the Soviet Union, marking one of the most significant geopolitical changes since the end of World War II.

What emerges clearly from the analysis is that the Just Transition does not merely influence power balances but is already reshaping alliances, interdependencies, and trade flows.

As global demand for fossil fuels decreases, alliances based on these resources are losing relevance. While they may persist for other strategic reasons, fossil energy will become a less central element. A notable example is OPEC, which has dominated the economic and geopolitical landscape since the 1960s. In a context characterised by expanding energy alternatives, OPEC's role could diminish, as evidenced by Qatar's recent departure to focus on natural gas.

Bilateral relations between states could also undergo significant transformations. The alliance between the United States and Saudi Arabia, historically based on a strategic exchange of military assistance for access to Saudi oil, may evolve as global dependence on oil diminishes. At the same time, many other states are redefining their energy diplomacy. This is not limited to European states or Japan, as previously highlighted, but also includes Middle Eastern countries. A notable example is the United Arab Emirates, which, despite being a major oil exporter, is investing heavily in renewable energy projects in both developed and developing countries, hosting IRENA and financing initiatives through the Abu Dhabi Fund for Development.

The most significant impact of the Just Transition, however, lies in the formation of new multilateral alliances. The 2015 Paris Climate Conference (UN, 2015) marked the emergence of initiatives such as the International Solar Alliance (ISA), the Global Geothermal Alliance, and Mission Innovation, aimed at fostering technological cooperation among governments, private companies, and non-governmental organisations. While many of these alliances are still in their early stages, their geopolitical potential is significant.

The shift to renewable energy could also reduce competition for natural resources such as oil and gas, mitigating some causes of conflict. However, new challenges could arise, related to cybersecurity and access to minerals essential for the energy transition, outlining a complex and constantly evolving geopolitical landscape.

In summary, the global energy transformation driven by renewables will have profound geopolitical repercussions, structurally altering relations among states, economies, and societies. The world that emerges will be radically different from one built around fossil fuels, with a more decentralised distribution of power and greater energy autonomy for many countries. States like China, which have heavily invested in renewable technologies, will gain increasing influence, while those heavily dependent on fossil fuel exports, if unable to adapt, risk losing relevance and stability.

The transition will redistribute control over energy, reducing the dominance of a small number of producer states and enabling many nations to aspire to energy independence, with benefits for national security and economic development. While the extent and speed of this transformation remain uncertain, its impact will be profound, creating new opportunities: improved energy security, economic growth, job creation, greater equity and sustainability, and a reduction in resource-related conflicts.

However, this transformation will not be without challenges. Fossil fuel-exporting countries could face economic crises and social instability if they fail to reinvent their economic models. A rapid shift away from fossil fuels could trigger global financial shocks, affecting communities and workers tied to these sectors. Furthermore, increasing reliance on strategic minerals and vulnerabilities linked to cybersecurity represent new areas of risk.

Despite these obstacles, the energy transition will mark a crucial step toward a more sustainable future, helping to combat climate change, reduce pollution, and promote prosperity and equitable development. To effectively address the geopolitical consequences of this transformation, it is essential for governments, businesses, and civil society to collaborate, using analyses and reports as tools to stimulate dialogue, define policies, and take concrete actions for a smooth and effective transition.

References

- Antonsich M. (1995), *Itinerari Geopolitici Contemporanei, Quaderni del Dottorato di Ricerca in Geografia Politica*, 5: 15-57.
- Bazilian M., Bradshaw M., Gabriel J., Goldthau A., Westphal K. (2019), Four scenarios of the energy transition: Drivers, consequences, and implications for geopolitics, *WIREs Climate Change*, 11(6): e625.
- Blondeel M., Bradshaw M. J., Kuzemko C., Bridge G. (2021), The geopolitics of energy system transformation: A review, *Geography Compass*, 15(7): e12580.
- Blondeel M., Price J., Bradshaw M., Pye S., Dodds P., Kuzemko C., Bridge G. (2024), Global energy scenarios: A geopolitical reality check, *Global Environmental Change*, 84:102781.
- Bradshaw M. (2009), The geopolitics of global energy security, *Geography Compass*, 3 (5):1920–37.
- Bridge G., Bouzarovski S., Bradshaw M., Eyre N. (2013), Geographies of energy transition: Space, place and the low-carbon economy, *Energy Policy*, 53: 331- 40.
- C el erier P. (1969), *G eopolitique et G eostrat egie*, Paris: Presses Universitaire de France.

Ćetković S., Buzogány A. (2019), The Political Economy of EU Climate and Energy Policies in Central and Eastern Europe Revisited: Shifting Coalitions and Prospects for Clean Energy Transitions, *Politics and Governance*, 7(1): 124 -128.

Cock J. (2018), *Contesting the colour of a Just Transition in South Africa*, Johannesburg: University of Witwatersrand.

Cohen S.B. (1963), *Geography and Politics in a Divided World*, New York: Random House.

Climate Group (2023), *Six climate priorities, six months out from COP28*, *The Climate Group*. <https://www.theclimategroup.org>

Conant A., Gold F. (1978), *The geopolitics of energy*, London: Routledge.

Cock, J. (2018), *Contesting the colour of a Just Transition in South Africa*, University of the Witwatersrand, Johannesburg, 24 April 2018. <https://www.wits.ac.za/news/latest-news/in-their-own-words/2018/2018-04/contesting-the-colour-of-a-just-transition-in-south-africa.html>

Dodds, K. and Woodward, J. (2021). *The Arctic: A Very Short Introduction*. Oxford: Oxford University Press.

EEAS (2023), *Geopolitics of the green transition and improving EU's economic security*. European External Action Service. <https://www.eeas.europa.eu>

European Bank for Reconstruction and Development (EBRD) (2023), *Transition Report 2023-24*, EBRD. Retrieved from <https://2023.tr-ebd.com/>

European Commission (2022), *Green Deal: EU agrees new law on more sustainable and circular batteries to support EU's energy transition and competitive industry*, Brussels: European Commission. https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7588

European Commission (2023), The Just Transition Mechanism, *European Green Deal*. <https://commission.europa.eu>

European External Action Service (EEAS) (2023), *Geopolitics of the Green Transition and Improving EU's Economic Security*, European Commission.

Forbes (2023), Inflation Reduction Act Benefits: Billions in Just Transition Funding for Coal Communities, *Forbes Business Energy*. <https://www.forbes.com/sites/energyinnovation/2022/08/24/inflation-reduction-act-benefits-billions-in-just-transition-funding-for-coal-communities/>

Fouquet R., Pearson P. (2012), Past and prospective energy transitions: Insights from history, *Energy Policy*, 50: 1–7.

Gass P., Gerasimchuk Y., Suharsono A., Moerenhout T., Oharenko Y., Zinecker, A. (2018), *Real People, Real Change Strategies for Just Energy Transitions*, IISD, Geneva. <https://www.iisd.org/sites/default/files/publications/real-people-change-strategies-just-energy-transitions.pdf>

Global Commission on the Geopolitics of Energy Transformation (2019), *A New World: The Geopolitics of the Energy Transformation*, IRENA, Federal Foreign Office Germany, Norwegian Ministry of Foreign Affairs and UAE Ministry of

Energy and Industry, Abu Dhabi. <https://www.irena.org/publications/2019/Jan/A-New-World-The-Geopolitics-of-the-Energy-Transformation>

Goldthau A., Youngs R. (2023). The EU Energy Crisis and a New Geopolitics of Climate Transition. *Journal of Common Market Studies*, 61: 115-124.

Green F., Denniss R. (2018), Cutting with both arms of the scissors: the economic and political case for restrictive supply-side climate policies, *Climatic Change*, 150(1-2): 73–87.

Hartshorne R. (1950), The Functional Approach in Political Geography, *Annals of the Association in Political Geography*, 40(2): 95-130.

Healy N., Barry J. (2017), Politicizing energy justice and energy system transitions: Fossil fuel divestment and a “just transition”, *Energy Policy*, 108: 451–459.

Herranz-Surrallés A. (2024), The EU Energy Transition in a Geopoliticizing World, *Geopolitics*, 29(5), 1882-1912.

IEA (2024), *Outlook for Producer Economies*. <https://www.iea.org/reports/outlook-for-producer-economies>

IRENA (2023), *Geopolitics of the energy transition: Critical materials*, International Renewable Energy Agency.
<https://www.irena.org/Publications/2024/Apr/Geopolitics-of-the-energy-transition-Energy-security>

IRENA (2023b), *World Energy Transitions Outlook 2023: 1.5°C Pathway*.
<https://solarquarter.com/wp-content/uploads/2023/07/1688542036127.pdf>

IRENA (2024), *Geopolitics of the energy transition: Energy security*.
https://www.apeg.pt/folder/documento/ficheiro/869_IRENA_Geopolitics_transition_energy_security_2024.pdf

IRENA (2024b), *Renewable capacity statistics*.
<https://www.irena.org/Publications/2024/Mar/Renewable-capacity-statistics-2024>

IRENA (2024c), *Global Atlas for Renewable Energy*.
<https://globalatlas.irena.org/workspace>

Jean C. (2003), *Manuale di Geopolitica*, Roma-Bari: Editori Laterza.

Just Transition Centre (2022), *Just Transition Issue Brief*, International Trade Union Confederation (ITUC).

Kuzemko C., Blondeel M., Bradshaw M., Bridge G., Faigen E. Fletcher L. (2024), Rethinking Energy Geopolitics: Towards a Geopolitical Economy of Global Energy Transformation, *Geopolitics*, May: 1-35.

Lazarus M., van Asselt H. (2018), Fossil fuel supply and climate policy: exploring the road less taken, *Climatic Change*, 150. 1–13.

Lizza G. (2001), *Geopolitica. Itinerari del Potere*, Torino: UTET.

Lizza G. (2011), *Geopolitica delle prossime sfide*, Torino: UTET.

Lizza G. (2021), *Gli orizzonti della nuova geopolitica. Verso il 20250*, Torino: UTET.

- Lizza G. (2024). The ecological transition in the current geopolitical context. *Unpublished Manuscript*.
- Mabon S. (2024), Israel-Gaza Conflict: How Could It Change the Middle East's Political Landscape?, *Middle East Policy Quarterly*.
<https://theconversation.com/israel-gaza-conflict-how-could-it-change-the-middle-east-political-landscape-expert-qanda-215473>
- Mamadouh V. D. (1998), Geopolitics in the nineties: One flag, many meanings. *Geo Journal*, 6 (4): 237–53.
- Mitchell J., Beck P., Grubb M. (1996), *The new politics of energy*, London: The Royal Institute of International Affairs.
- Morgan S. (2019), *EU climate deal falls at summit, four countries wield the axe*, Euractiv. <https://www.euractiv.com/section/energy-environment/news/eu-climate-deal-falls-at-summit-four-countries-wield-the-axe/>
- Munich Security Conference (2021), *Power Shifts: On the Geopolitics of the Energy Transition*. <https://securityconference.org>
- Newell P. (2023), Mind the Gap: The Global Governance of Just Transitions, *Global Policy*, 14(2), 257–271.
- Newell P., Mulvaney D. (2013), The Political Economy of the Just Transition, *Geographical Journal*, 179(2), 132–140.
- Odell P. (1974), *Oil and world power: Background to oil crisis*, Middlesex: Penguin.
- PBS News (2022), What the Inflation Reduction Act does for green energy, *PBS NewsHour*. <https://www.pbs.org>
- Schlesinger J. (1979), The geopolitics of energy, *The Washington Quarterly*, 2 (3): 3-7. doi: 10. 1080/01636607909477403.
- Schwartzkopff J., Schulz S. (2017), *Poland: The Political Economy of The Low-Carbon Transition. Climate & Energy Snapshot*, E3G, London.
<https://www.jstor.org/stable/resrep17776>
- Schulz S., Amon A., Goritz A., Schwartzkopff, J. (2017), *Hungary: The Political Economy of the Low-Carbon Transition*, E3G. https://www.e3g.org/wp-content/uploads/docs/Climate_and_energy_snapshot_HU.pdf
- Shen Y., Moomy R, Egger R.G (2020), China's public policies toward rare earths, 1975–2018, *Mineral Economics*, 33/1-2: 127-51.
- Skalamera M. (2023), The Geopolitics of Energy after the Invasion of Ukraine, *The Washington Quarterly*, 46(1): 7-24.
- Strambo S. (2020), *Just transition and the geopolitics of decarbonization in the EU*, MISTRA Geopolitics, The Swedish Foundation for Strategic Environmental Research. <https://www.mistra-geopolitics.se/decarbonization/>
- United Nations (UN) (2015), *Paris Agreement*, United Nations.
<https://unfccc.int/process-and-meetings/the-paris-agreement>

United Nations (UN) (2024), *UN Climate Change Conference Baku - November 2024*, United Nations Framework Convention on Climate Change.

<https://unfccc.int/cop29>

United Nations Development Programm (UNDP) (2022), *Promoting Justice in Energy Transitions: A Framework for Inclusive Policies*, United Nations.

United NationDevelopment Programme (UNDP) (2023), *Navigating The Path to A Just Transition: Employment Implications of China's Green Transition*, United Nations.

USGS and US Department of the Interior (2022), *Mineral Commodity Summaries 2022*, United States Department of the Interior, United States Geological Survey, Reston, Virginia. <https://pubs.usgs.gov/>

Vakulchuk R., Overland I., Scholten, D. (2020), Renewables, climate change, and geopolitics: Energy transition scenarios, *Nature Energy*, 5(8): 610-620.

Yang Y., Xia S., Qian X. (2023), Geopolitics of the energy transition, *Journal of Geographical Science*, 33: 683–704.

Yergin D. (2012), *The prize: The epic quest for oil, money & power*, London: Simon & Schuster.

